

# An update on the epidemiology of RF

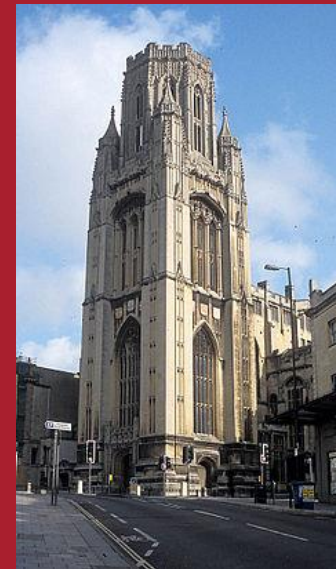
*...with links to current 5G controversies*

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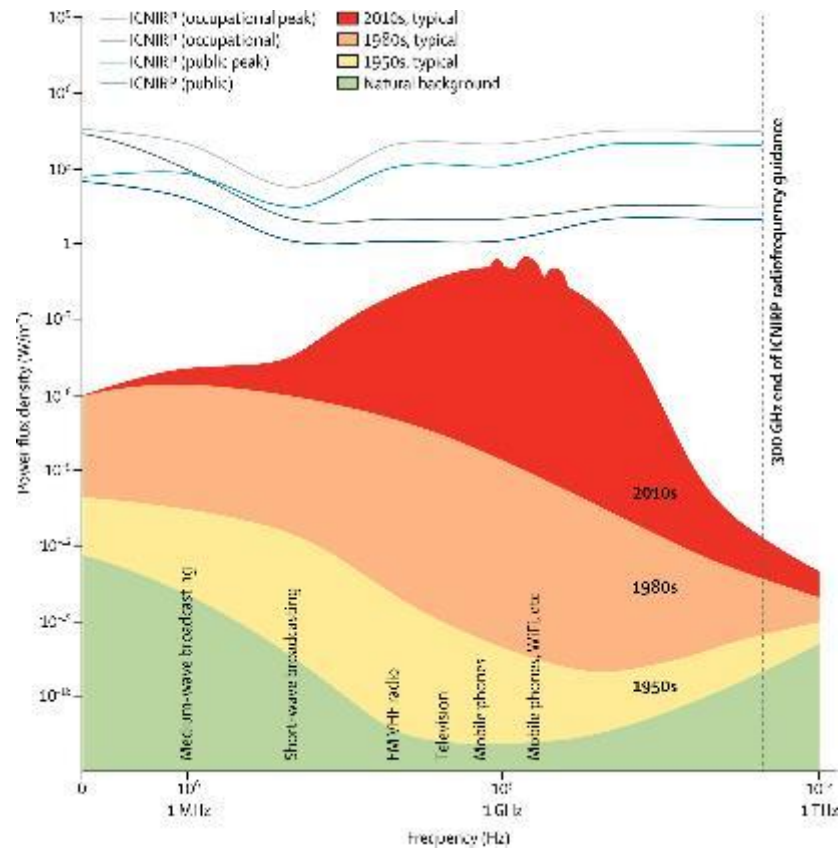
[bristol.ac.uk](http://bristol.ac.uk)



[frank.devocht@bristol.ac.uk](mailto:frank.devocht@bristol.ac.uk)

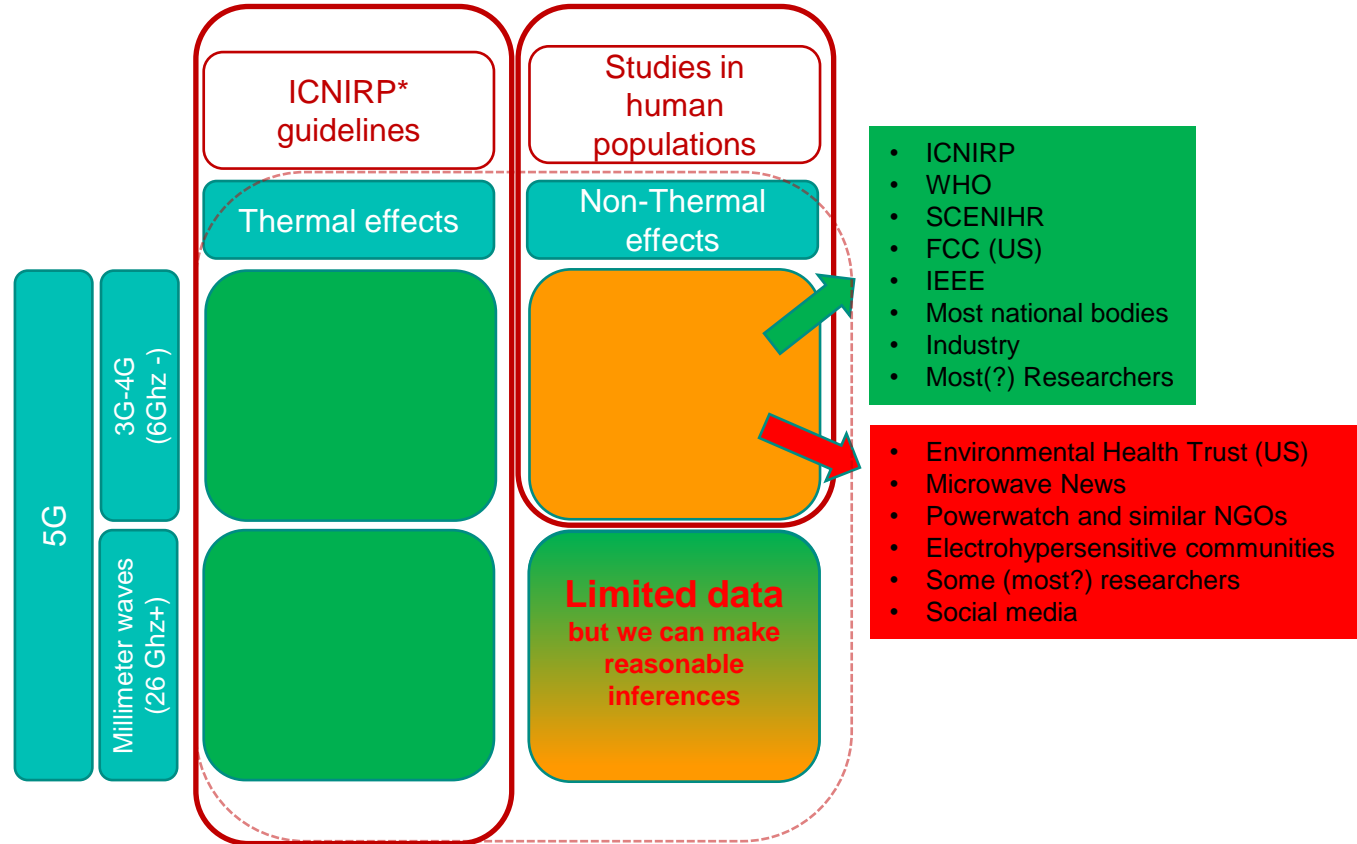


@frankdevocht



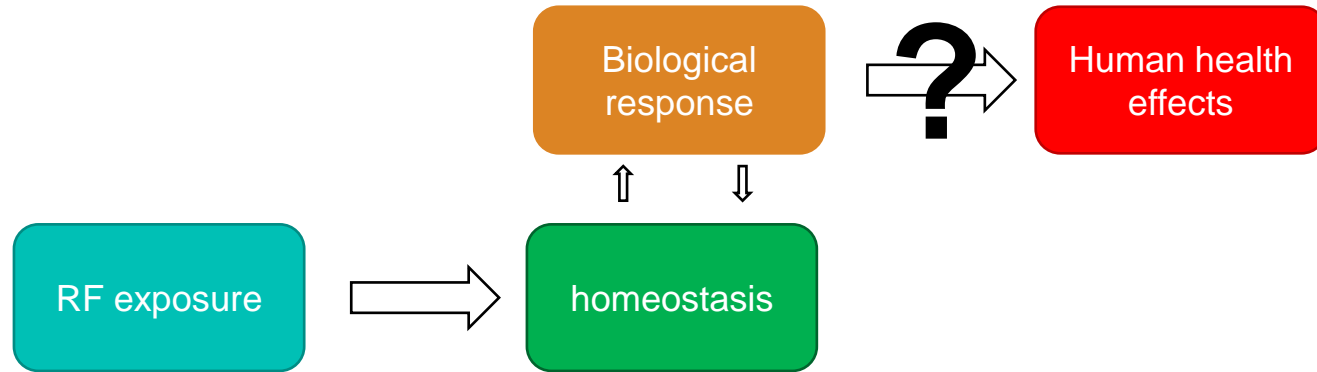
# Mobile phone RF epidemiology

## general concepts



# Mobile phone RF epidemiology

general concepts



# An overview of RFR and health outcomes

- Cancer
- Fertility
- Development and behaviour
- Electrohypersensitivity
- Immune system



# Contribution to health effects



## Cancer

### In cells and animals

- Some data of biological (for example DNA strand breaks), possibly genotoxic, effects in cell systems
- Studies in rats, but not mice, ('NTP') suggest increased risks of glioma and schwannoma, but problems with interpretation of results
- Studies in rats ('Ramazinni') also showed increased risk of schwannoma, but not glioma
  - ...but exposure levels don't match those of NTP

### In humans

- Small excess risk for heaviest MP users cannot be completely excluded
- Possible health hazard, but increasingly unlikely an important cancer risk factor



# Contribution to health effects



## Fertility

- Evidence mainly from studies in cells and animals
- Decline in sperm count since 1970s, especially in industrialized world
- Reactive oxygen species (ROS) levels proposed as non-thermal mechanism, but limited evidence in human populations
- Sperm development sensitive to heat, and carrying a phone in trouser pocket carries a theoretical hazard (little evidence of risk)



# Contribution to health effects



## Development, cognition and behaviour

- Causal relations cannot be excluded, but most likely other causal mechanism

## Electrohypersensitivity

- Remains unclear whether health effects are caused by EMF / RFR
- But cannot be dismissed 'out-of-hand'





# Electrohypersensitivity

*Idiopathic Environmental Intolerance attributed to Electromagnetic Fields (IEI-EMF)*



- 1%-10% of the population self-diagnoses as suffering from IEI-EMF
- Plethora of symptoms:
  - including skin symptoms, fatigue, headache, insomnia, dizziness, tinnitus, cardiovascular symptoms, myalgia (muscle pain), arthralgia (pain in joints), anxiety, emotivity, irritability, depression, short term memory ....
- Remains unclear whether IEI-EMF should be attributed to
  1. electromagnetic radiation
  2. entirely psychosomatic
  3. combination of both
- Evidence from randomized, blinded experiments suggests 2
- However, there are some limitations of experimental studies
- Conceivable some people may be susceptible to radiation



# Contribution to health effects

## Immune System



- Evidence of biological effects of RFR, with ROS as proposed mechanism
- No evidence direct impact on health via immune system
- This is the basis for the 5G/COVID-19 conspiracy theory

## Reactive oxygen species (ROS)

- January 2021 BERENIS Newsletter
- Majority animal/ cell studies provide evidence of increased oxidative stress
- Changes in oxidative balance can occur in low dose range
- ...however, organisms and cells are generally able to react to oxidative stress



# RF exposure



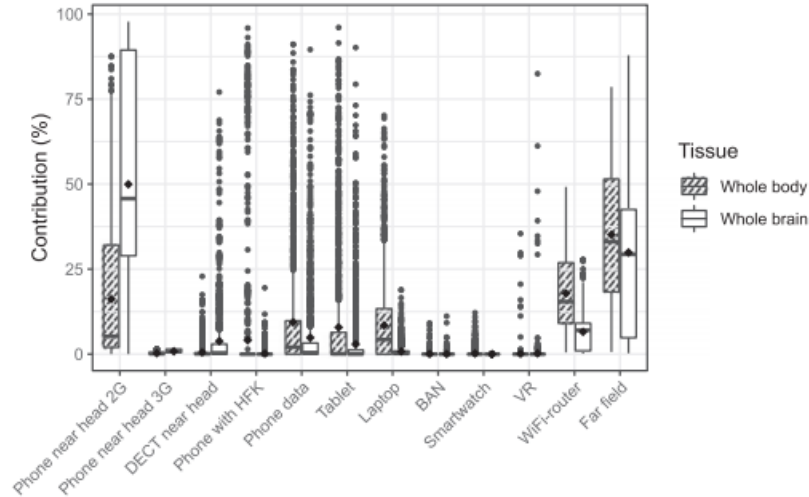
**Table 1** Absolute dose in (mJ/kg/day) for whole-body and whole-brain.

Source	Whole-body (mJ/kg/day)				Whole-brain (mJ/kg/day)			
	P <sub>5</sub> <sup>a</sup>	Median	P <sub>95</sub> <sup>a</sup>	Mean	P <sub>5</sub> <sup>a</sup>	Median	P <sub>95</sub> <sup>a</sup>	Mean
<b>Overall</b>	<b>80.1</b>	<b>183.7</b>	<b>867.3</b>	<b>290.4</b>	<b>85.0</b>	<b>204.4</b>	<b>3323.7</b>	<b>810.5</b>
Near-field, total	5.3	98.7	756.0	199.3	5.1	105.1	3235.1	719.6
Phone near head, 2G	0.0	5.3	236.8	49.0	0.0	70.4	3168.7	656.1
Phone near head, 3G	0.0	0.1	3.9	0.8	0.0	1.2	51.9	10.7
DECT phone near head	0.0	0.3	2.4	0.9	0.0	4.5	31.9	11.9
Phone with HFK <sup>b</sup>	0.0	0.0	343.0	37.9	0.0	0.0	1.5	0.2
Phone data	0.0	4.1	224.5	46.5	0.0	2.2	112.4	23.9
Tablet	0.0	0.2	212.8	42.6	0.0	0.0	59.3	13.3
Laptop	0.0	4.9	77.8	20.5	0.0	0.6	10.1	2.2
Body area network	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.1
Smartwatch	0.0	0.0	2.9	0.5	0.0	0.0	0.0	0.0
Virtual reality headset	0.0	0.0	0.0	0.4	0.0	0.0	0.0	1.2
Near-to-far-field, total	28.3	28.3	28.3	28.3	13.6	13.6	13.6	13.6
Wi-Fi-router	28.3	28.3	28.3	28.3	13.6	13.6	13.6	13.6
Far-field, total	29.6	56.6	124.0	62.8	36.1	68.4	121.8	77.3
Downlink	8.3	24.1	42.2	24.1	11.3	37.1	52.9	33.1
Uplink	10.1	15.7	23.3	15.9	15.3	22.6	29.6	21.6
Broadcast	4.9	12.0	53.6	19.2	2.6	7.7	16.8	8.2
DECT	0.5	1.3	4.3	1.9	0.6	5.1	34.0	13.0
Wi-Fi	1.0	1.9	2.5	1.7	0.7	1.4	1.8	1.3

<sup>a</sup>P<sub>5</sub> and P<sub>95</sub> are the 5th and 95th percentile, respectively.

<sup>b</sup>Hands-free kit.

# RF exposure



**Fig. 1** Relative contribution of sources to total dose of whole-body and whole-brain (HFK hands-free kit, BAN body area network, VR virtual reality headset). Percentile distribution is shown using

# ...a little bit about 5G



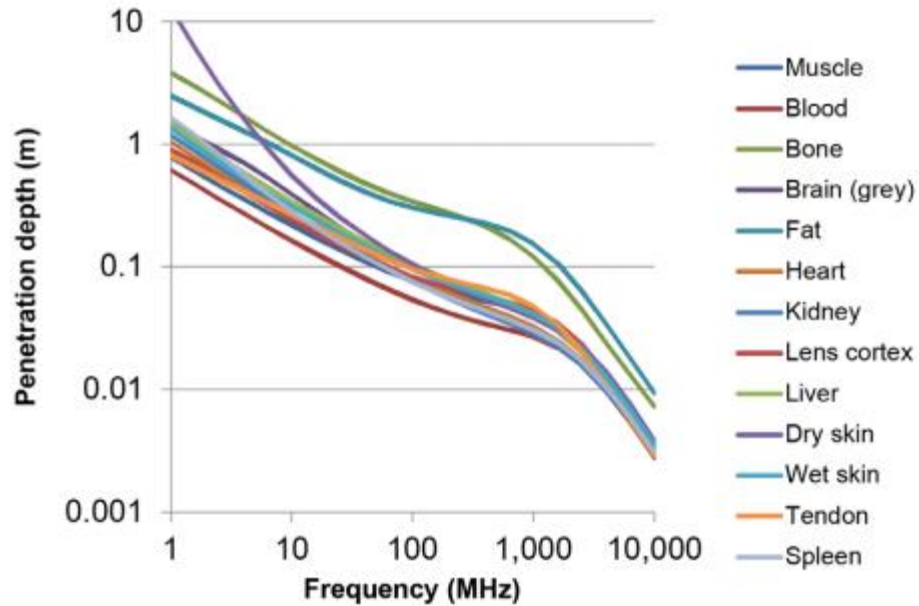
- Exposure expected to be similar or lower than 2-4G, but does add 3 Ghz+

(Rumney. 5G Safety. Myths, Maths & Medicine. Cambridge Wireless Journal June 2019;2(4); Ofcom Technical Report Feb 21 2020)

- Relatively little data available 3 Ghz+

- Several review publications:

- Simko and Mattsson. 5G Wireless Communication and Health Effects – A pragmatic review based on available studies regarding 6 to100 GHz. Int J Env Res Publ Health 2019;16:3406
- Hardell and Carlberg. (Comment) Health risks from radiofrequency radiation, including 5G, should be assessed by experts with no conflicts of interest. Oncology Lett 2020; 20:15
- Bushberg et al. IEEE Health and Safety Issues ... 5G Wireless Communication Networks. Health Physics 2020;119(2):236-246
- Betzalel et al. The human skin as a sub-THz receiver- Does 5G pose a danger or not. Environ Res 2018;163:208-2016
- Russell. 5G wireless telecommunications expansion: Public health environmental implications Environ Res2018;165:484-495
- Di Ciaula. Towards 5G communications systems: Are there health implications? Int J Hyg Environ Health 2018;221:367-75
- Kostoff et al. Adverse health effects of 5G mobile networking technology under real-life conditions. Toxicol Letters 2020; 323:35-40
- Leszczynski. Physiological effects of millimeter-waves on skin and skin cells: an overview of the to-date published studies. Rev Env Health 2020 ;doi: 10.1515/reveh-2020-0056
- Karipidis et al. 5G mobile networks and health-a state-of-the-science review of the research into low-level RF fields above 6 GHz. J Exp Sci Env Epi 2021. doi: 10.1038/s41370-021-00297-6.
- Ahmed et al. COVID-19 and the 5G Conspiracy Theory: Social Network Analysis of Twitter Data. J Med Internet Res 2020;22(5):e19458
- Frank (Comment). Electromagnetic fields, 5G and health: what about the precautionary principle? J Epi Comm Health. 2021;jech-2019-213595. doi: 10.1136/jech-2019-213595



Source: Houston et al. *Reproduction* 2016; 152(6):R263-R276



# Summary



## Current RF exposures

- **Cancer risk:** Increasingly unlikely RFR is an important factor
- **Fertility:** associations plausibly result from study weaknesses or other exposures
- **Development, cognition and behaviour:** Weak evidence, possibly attributed to excessive/nighttime use instead
- **Immune system:** Possible immune parameter responses, but no evidence this results in human health effects

## 5G

- Exposure
  - <3Ghz environmental exposures in future unclear, but unlikely sufficiently higher for 5G to increase health risks
  - Mm-waves unlikely to exacerbate effects in humans
- Remain gaps in research in human populations for 3 Ghz+
- Areas of attention are cancers of the skin and eye, and possibilities of local heating (in particular testicular tissue)

# Health Council of the Netherlands



- 5G and health report 2020 (largely comparable to French ANSES advice)
- *“...it cannot be excluded that the incidence of cancer, reduced male fertility, poor pregnancy outcomes and birth defects could be associated with exposure to radio frequency electromagnetic fields.”*
- *“However, .... the relation between exposure and these and other diseases or conditions neither proven nor probable.”*
- *The committee recommends:*
  - *not to use the 26 GHz frequency band for 5G for as long as the potential health risks have not been investigated.*
  - *use International Commission on Non-Ionising Radiation Protection (ICNIRP) as the basis for exposure policy*





# Main Messages

- It is unlikely that 5G will exacerbate health impact compared to 2-4G
- Evidence of health harm from 2-4G limited
  - possible exceptions at highest exposure*
- Data on mm Waves insufficient, so extra studies would be welcome
  - areas of interest cancers of the skin and eyes*

## However:

- Non-thermal biological effects of RF exist
- ..but link to subsequent human health effects not convincing
- Nonetheless “there is no plausible biological mechanism” not entirely correct:
  - *Several possible mechanisms reported*
  - *Most plausible is reactive oxygen species (ROS)*



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For background:

Frank de Vocht. *5G Health Fears: An Epidemiological Approach*. Cambridge Wireless Journal Nov 2019. <https://flickread.com/edition/html/5dc345f09c736#10>

Moray Rumney. *5G Safety. Myths, Maths & Medicine*. Cambridge Wireless Journal Jun 2019. <https://flickread.com/edition/html/5d0cb90aee811#16>